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Food & Nutrition Research Briefs

Too Much Soda May Rob Bone Minerals

Preliminary findings suggest that drinking lots of non-diet sodas coupled with eating few leafy greens, nuts and whole grains may compromise bone building and maintenance, according to an ARS study. It's a dietary combination quite common among U.S. youths. Drinking 57 ounces—close to 5 cans—of sugary sodas each day for weeks at a stretch upset the calcium and phosphorus balances of the 11 young men in the study. And the effect on these bone minerals was greatest while the experimental diets were low in magnesium, the researchers reported in the *Proceedings of the North Dakota Academy of Science* (vol 51, p 212).

Non-diet sodas are a major source of fructose in the U.S. diet. Leafy greens, nuts and whole grains are rich in magnesium. But 38 percent of U.S. males over age 19—and 39 percent of male teens—get less than 75 percent of the recommended magnesium intake through foods, according to recent USDA consumption data. Statistics for females are worse: 46 percent over age 19 and 60 percent of teens.

Males drink more regular soft drinks, however, averaging close to one 12-ounce can daily. Teenage males average about 20 ounces a day. And some regularly consume as much as the study volunteers.

All that soda put the volunteers “in the red” for phosphorus. They excreted more than they absorbed—both when they got adequate magnesium and when they got half the Recommended Dietary Allowance (RDA). Besides being a major bone mineral, phosphorus is central to cells’ energy production system and is integral to DNA and its sister RNA. The volunteers’ calcium balance remained positive but dropped, especially during the low-magnesium period.

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Saving Bone Lost to Eating Disorders

Mild doses of synthetic female hormones, estrogen and progestin, may prevent bone loss in young women who have stopped menstruating because of eating disorders or

excessive exercise, a study suggests. This condition, known as hypothalamic amenorrhea, can be especially risky for teenage girls whose bones are still developing because it increases the risk of osteoporosis later in life.

In an attempt to reverse bone loss in these cases, researchers with Baylor College of Medicine and ARS's Children's Nutrition Research Center, both in Houston, collaborated on a year-long study of 24 young women, ages 14 to 28. Under the guidance of the Baylor physician, the women were divided into three treatments: a combination estrogen and progestin tablet for 21 of the 28 days in the cycle; a progesterone formulation for the last 12 days of the cycle; or a look-alike placebo. Their bone density was measured at the ARS center before, during and after treatment.

After a year, the women taking the estrogen and progestin preparation had significantly more bone mineral in their total skeletons and in the lower spine compared to the other two groups. The researchers believe that the treatment mimics the hormonal activity of the normal menstrual cycle and helps protect the bones against mineral loss until other medical care can restore the patients’ general health—and natural menstrual cycle.

This research was published in the *American Journal of Obstetrics and Gynecology* (vol. 176, pp. 1017-1025). Since the number of women studied was very small, further study is needed. But if the results prove consistent, physicians will have a new path to explore in treating bone loss for the five to ten percent of American women and girls who suffer from eating disorders.

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Better Extraction of Ancient Herbs

ARS scientists are finding better ways to mine ancient herbs, like St. John’s wort and wormwood, for their curing compounds and for safer natural pesticides. The agency recently established a Natural Products Utilization Research Unit, based in Oxford, Mississippi. Among the research

team's successes are improved extraction techniques for annual wormwood to obtain artemisinin, a potent malaria-fighting drug. The team also is improving extraction techniques for St. John's wort. This plant yields mood-enhancing compounds, according to studies published in medical journals.

The researchers find better extraction methods by studying plant physiology. In the case of wormwood, the ARS team found that the tiny balloon-like glands on the plant's leaves are filled with artemisinin. In nature, the glands serve as built-in biopesticide applicators. The glands rupture during insect attacks, oozing micro-doses of artemisinin and other compounds that repel the pests.

In studies with St. John's wort, the scientists are improving extraction methods for hypericin, which many scientists believe is responsible for the plant's benefits. The usual approach is to crush the plant, but ARS research suggests this releases enzymes that can destroy the hypericin.

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Device May Aid Pregnancy Monitoring

An expectant mother's chances of delivering a healthy, normal-weight baby may increase in the future, thanks to a promising new technique—bioimpedance spectroscopy—for monitoring water-weight gain during pregnancy. Physicians have known for more than four decades that moderate water accumulation during pregnancy is a strong indicator of proper fetal growth.

Scientists with ARS, the University of California at Berkeley, and Xitron Technologies, Inc., San Diego, Calif., showed that bioimpedance measurements correlate significantly with infant birth weight. The researchers measured water-weight gain of 10 women before pregnancy, at intervals throughout pregnancy, and after delivery. The measurements are painless and take less than two minutes to perform. They involve sending a harmless current between electrodes positioned on the hand and foot, as described in the *Journal of Applied Physiology* (vol. 78, pp. 1037-1042).

The ARS-led investigation is likely the first to show that bioimpedance spectroscopy may offer a safe, accurate and inexpensive way for physicians to detect subnormal water-weight gains in time to help their patients take corrective action. Low-birth-weight babies—weighing less than 5.5 pounds at birth—have an even greater risk of early health complications than premature babies. An expectant mother who does not eat properly, exercises too vigorously, takes diuretics or abuses drugs, for example, may deliver an underweight infant.

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Vitamin D Could Be Sunnier For Elders

Vitamin D status is better for elderly men and women in the general population than for elderly hospital patients. But this first population-based study of vitamin D suggests inadequacy is an important public health problem in older Americans. Vitamin D is essential for healthy bones and teeth and helps prevent osteoporosis.

Researchers with USDA's Human Nutrition Research Center on Aging at Tufts and the Framingham, Mass., Heart Study conducted the study with 759 free-living volunteers, age 67 to 95. About 15 percent of the women and 6 percent of the men had low blood levels of 25-hydroxyvitamin D—the major circulating form of vitamin D and the most sensitive measure of D status. About 4 percent of the women and 2 percent of the men were deficient, the researchers reported in the *American Journal of Clinical Nutrition* (vol. 66, pp. 929-936).

Milk is fortified with the vitamin as are some breakfast cereals. Fatty fish, egg yolks, liver, cheese and butter are naturally rich sources. And sunlight stimulates skin to manufacture the vitamin. The study data confirm the importance of eating foods rich in vitamin D and exposing skin to sunlight.

Participants' blood levels of D rose in step with intakes, plateauing only for men after daily intakes reached 400 International Units—twice the Recommended Dietary Allowance. Two-thirds of the volunteers drank less than 8 ounces of milk daily, which would supply half the RDA. Vitamin D supplements were a significant factor for the women's status and nearly so for the men's. Only 25 percent of the women and 20 percent of the men took vitamin D supplements. Vitamin D levels were highest in late summer—after months of long, sunny days—and lowest in late winter. Low D status was inversely associated with time outdoors. The study was funded by the National Institutes of Health and ARS.

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Big Shock Makes Tender Beef

Tender, affordable meats with less fat could come from technology that uses shock waves to improve the texture of everything from lamb chops to steaks. Underwater shock waves from a high-energy explosive charge tenderize meat with pressures as high as 25,000 pounds per square inch. Known as hydrodyne, the technology provides an alternative to fat as a source of tenderness. It can improve tenderness of less tender meat by 50 to 70 percent, well exceeding the previous goal of 40 percent improvement. Taste tests by ARS scientists showed it made inexpensive cuts of meat taste like higher-priced ones.

Hydrodyne was invented by a mechanical engineer retired from the Department of Energy. The technology is being evaluated by ARS scientists familiar with the meat industry's needs. Together, they are fine-tuning hydrodyne to make it industry ready. The next step will be training workers in its use.

A prototype at Tenderwave, Inc., in Buena Vista, Virginia, can tenderize 600 pounds of meat at once. A 7,000-pound steel tank filled with water is covered with an 8-foot-diameter, 5,000-pound steel dome. Large primal cuts of meat, encased in water- and pressure-resistant wrapping, are lowered into the tank. Then an explosive charge is set off in the water about 2 feet from the meat. The tank's dome holds in water that is forced upwards. The ARS scientists will explore alternatives to explosives for discharge systems.

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Reliable Colon Cancer Screening?

Live colon cells isolated from stool samples may soon give physicians a reliable, noninvasive early warning technique for colorectal cancer. This disease causes about 14 percent of all cancer-related deaths in the U.S. It begins as abnormal growths, or polyps, 3 to 5 years before a malignancy appears. The current noninvasive screening method—which checks for blood in fecal smears—is plagued with false positives and false negatives. And a true positive reading means the tumor is fairly advanced.

Instead, a screening method based on subtle changes in the genes and surface proteins of isolated colon cells could prove far more useful. An ARS chemist developed the method for isolating live, intact colon cells from the stool. He then collaborated with a gastroenterologist at Sinai Hospital of Baltimore to look for markers in these cells. The researchers found that CD44—the tell-tale marker reported on other types of cancer cells—also appears on the surface of isolated colon cells. They have also detected mutated genes in these cells, indicating malignancy. They discussed the potential of this screening technique in an editorial in *Gastroenterology* (vol. 114, pp. 1333-1334).

The editorial accompanies a report by Japanese researchers (pp. 1196-1205) who isolated colon cells and found variants of the CD44 marker that might make sensitive indicators of precancerous conditions. British researchers reported a

strong correlation between the amount of DNA in isolated colon cells and the presence of tumors in *Clinical Cancer Research* (vol. 4, pp. 337-342). That's because rapidly dividing cells contain more DNA.

It's possible that, in five years, stool samples will routinely be analyzed for an array of tell-tale markers and gene mutations. This technique is already one of the first molecular biology assays to be evaluated in a clinical setting, the researchers report.

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Move Over, Chemical Pesticides

New technology could help viruses, bacteria and other environmentally friendly biopesticides compete with traditional chemical pesticides. ARS scientists and cooperators in Mexico have produced improved formulations that feature economy, reliability and user friendliness, according to their report in the *Journal of Economic Entomology* (vol. 91, pp. 86-93).

CONFERENCE ANNOUNCEMENT

What We Eat in America: Research and Results

Highlights of the 1994-96 nationwide Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey will be presented at a 2-day conference, September 14-15, at the Double Tree Hotel, Rockville, MD. The conference—free of charge—will include a session on use of the CD-Rom for survey results and another on the USDA's food coding, nutrient and Pyramid servings databases. Program and registration information are listed on the Food Surveys Research Group web site: <http://www.barc.usda.gov/foodsurgery/home.htm>. Or, contact Rhonda Sebastian, (301) 734-8482, rsebastian@rbhnrc.usda.gov

Called microencapsulation, the technology involves mixing microbes with a matrix-forming material, such as cornstarch that has been heated, or partially gelatinized, to enable water absorption. When the mixture is added to water and dried, the microbes become entrapped in tiny protective particles. Resuspended in water, the particles can be applied to crops using conventional spray equipment.

Until now it's been difficult to market encapsulated biopesticides because there was no single formulation appropriate for different crops and field-spraying equipment. The amount of ingredients such as sun protectants added to boost a formulation's effectiveness depended on how much water was needed for the mix. With the new technology, these ingredients—called adjuvants—are mixed into formulations as they are manufactured. The adjuvants are uniformly bonded with starch and the biopesticide, remaining stable throughout conventional tank mixing and application.

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Anti-Cancer Drugs Via Horseradish?

An enzyme in horseradish could make it easier to produce anti-cancer drugs, saving time and money. An ARS researcher devised a one-step method, using the enzyme horseradish peroxidase, to make cancer drugs known as chlorins. Currently, chlorins are made in a costly multi-step process.

All plants use a form of peroxidase to make cell walls, but the horseradish version is extremely easy to extract. The researcher made chlorins by combining the horseradish enzyme and a chemical cousin of chlorophyll. Plants use chlorophyll to turn light energy into food. But scientists doing research studies frequently turn to chlorophyll's cheap, easier-to-use synthetic cousin, deuteroporphyrin IX. The method is published in the *Archives of Biochemistry and Biophysics* (vol. 351, pp. 27-34).

Now, the University of Mississippi School of Pharmacy will test human cell cultures to ensure chlorins made this way are still effective photodynamic drugs. Photodynamic compounds kill tumors when exposed to red light from tiny lasers. First, the drug is injected and carried through the body by blood proteins. Because cancer cells grow 10 times faster than healthy cells, they take in much more of the drug than healthy cells. After a few days, a physician shines a red laser light on the tumor. Nearby healthy cells—transparent to the red light—are unaffected. But the chlorin molecules in the tumor cells are energized by red light and produce free radical oxygen molecules that destroy them.

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Healthful, New Sunflower Oil

NuSun, a healthful vegetable oil from new sunflower hybrids, is designed to make foods taste better and stay fresh longer. The new oil is low in saturated fat but high in the monounsaturated fat, oleic acid. Some studies indicate that a moderately low-fat diet with a high oleic acid content lowers serum cholesterol and the risk of coronary heart disease. With 60 to 75 percent oleic acid, NuSun has

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several times more than traditional sunflower oil and less than half as much of the polyunsaturated fat, linoleic acid.

However, linoleic acid content is still high enough for desired flavor in fried foods. In sensory panel evaluations, tortilla chips fried in NuSun oil stayed fresh tasting longer than chips fried in commercial sunflower oil. NuSun holds up well in frying vats even without hydrogenation, a process normally required to protect oils from flavor deterioration.

This year, growers planted 100,000 acres of NuSun hybrids. The new sunflowers could spur a doubling of U.S. oilseed sunflower acreage from its present 2.2 million acres by 2001.

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Surfing for Folate, Other Nutrients

Want to know how much folate (folic acid) you're getting from foods, now that millers and bakers are fortifying breads, flour, cornmeal, rice, pasta and other enriched grain products with the vitamin? Just take the World Wide Web to the home page of the Agricultural Research Service's Nutrient Data Laboratory: <http://www.nal.usda.gov/fnic/foodcomp>. There, you'll find the latest update of the main source of food composition data in the United States, technically known as Nutrient Database for Standard Reference, Release 12, or SR-12 for short.

The database has values for as many as 81 nutrients in 6,000 foods among 22 food groups. It's the only such database worldwide that's free. Some 8,000 visitors access the web site each month. Many arrive there via one of 400 web sites around the world with links to the USDA nutrient database.

SR-12 includes newly revised folate values for enriched grain products and foods in which they are ingredients. Also new are selenium values for many food items. An essential nutrient in the body's antioxidant functions, selenium has gained attention for its purported anti-cancer properties.

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